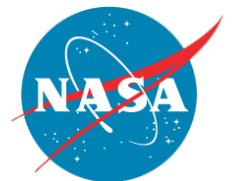


Global and North American Land Data Assimilation System (GLDAS and NLDAS)

NASA Remote Sensing Training
Norman, Oklahoma, June 19-20, 2012

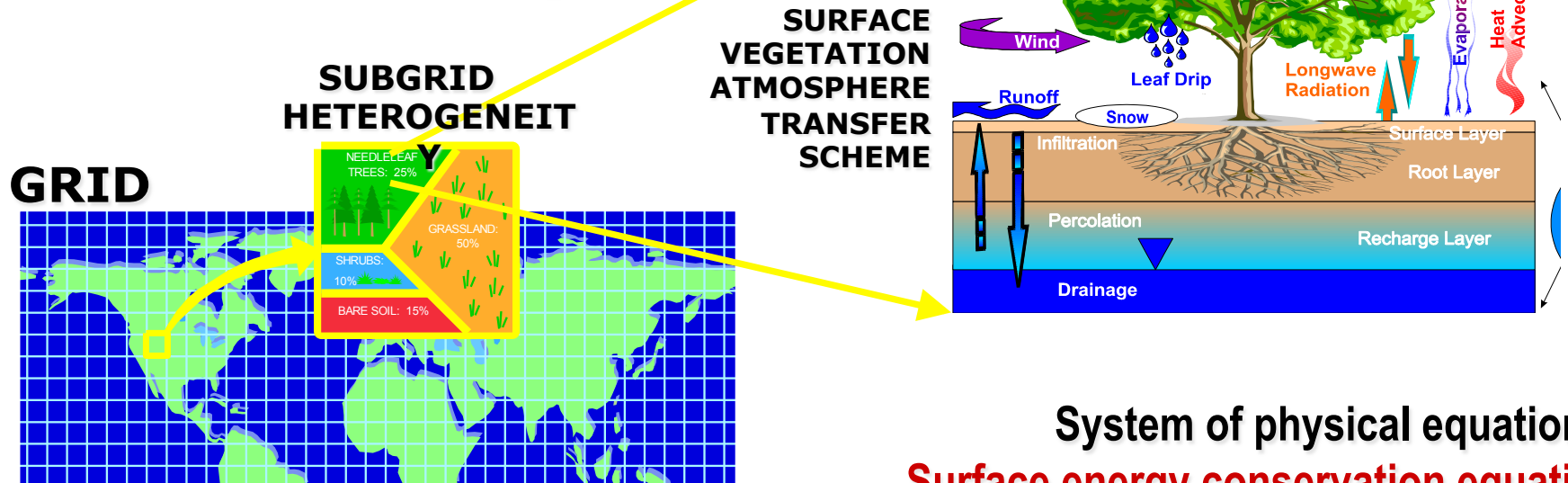
ARSET
Apply**R**emote **S**ensing **T**raining

A project of NASA Applied Sciences



Numerical Land Surface Models (LSM)

LSMs solve for the interaction of energy, momentum, and mass between the surface and the atmosphere in each model element (grid cell) at each discrete time-step (~15 min)



System of physical equations:
Surface energy conservation equation
Surface water conservation equation
Soil water flow: Richards equation
Evaporation: Penman-Monteith equation
etc.

LSM Input and Output Fields

Input Parameters:

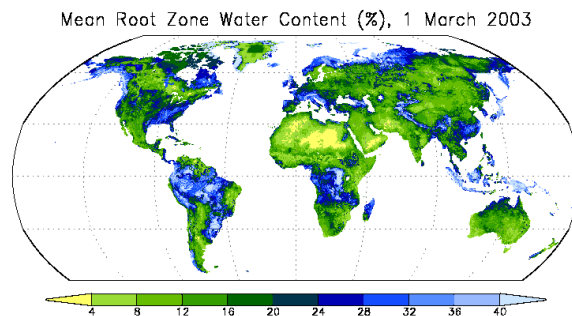
vegetation class
vegetation greenness/LAI
soil type, elevation

Required Forcing Fields:

total precipitation
convective precipitation
downward shortwave radiation
downward longwave radiation
near surface air temperature
near surface specific humidity
near surface wind speed (U & V)
surface pressure

Summary of Output Fields:

soil moisture in each layer
snow water equivalent
soil temperature in each layer
surface and subsurface runoff
evaporation
transpiration
latent, sensible, and ground heat fluxes
snowmelt
snowfall and rainfall
net shortwave and longwave radiation



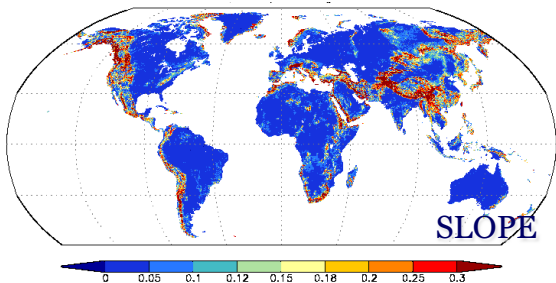
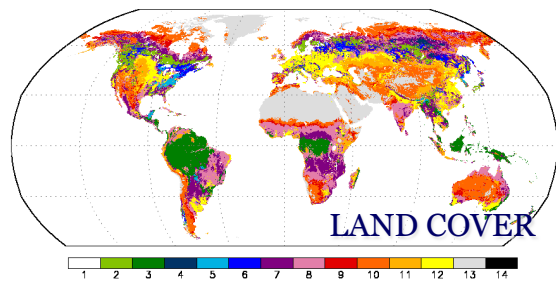
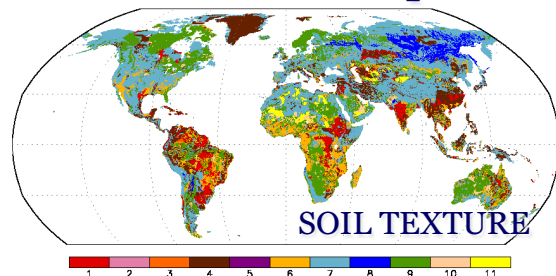
Courtesy Matt Rodell, NASA-GSFC

Global Land Data Assimilation System (GLDAS)

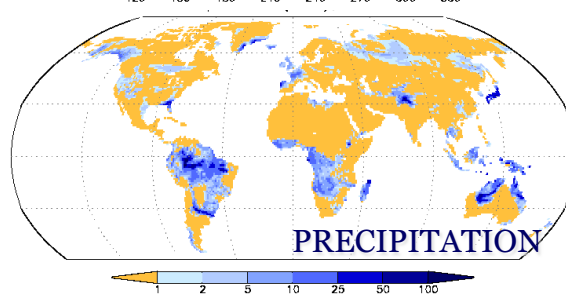
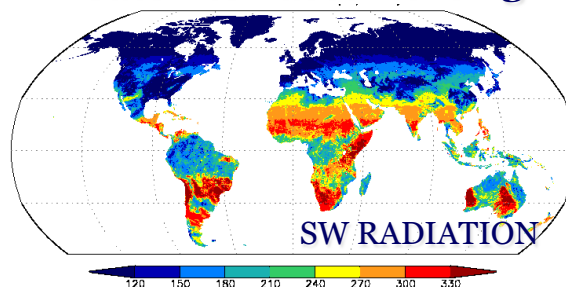
GOAL: Integrate ground and satellite observations within sophisticated numerical models to produce physically consistent, high resolution fields of land surface states (e.g., snow) and fluxes (e.g., evaporation)

USES: Weather and climate forecast initialization studies, water resources applications, hydrometeorological investigations

Parameter Inputs

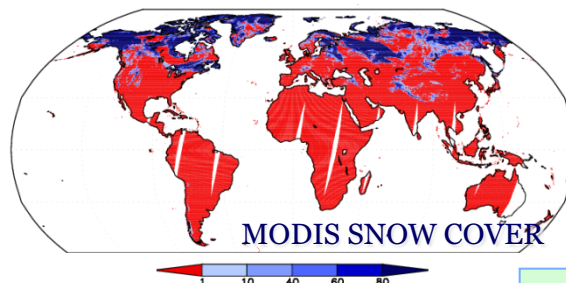


Satellite Based Forcing

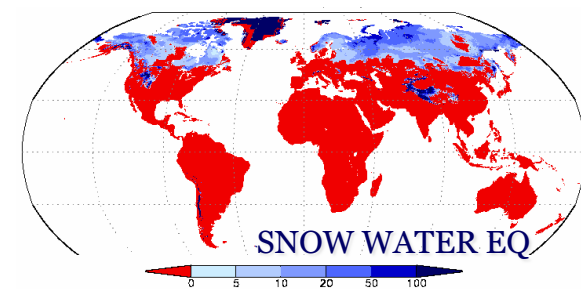
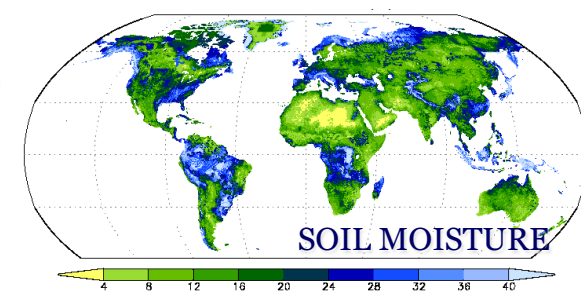
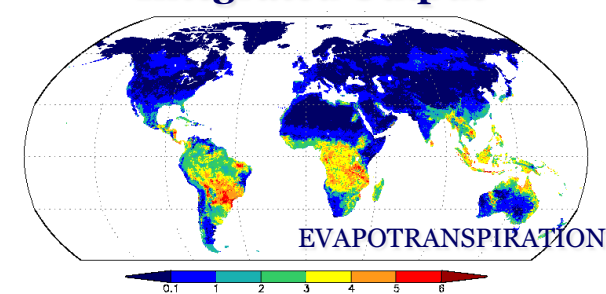


AVAILABILITY: Output from 1979-present simulations of Noah ($1/4^\circ$; 1°), CLM (1°), and Mosaic (1°), and VIC (1°), at <http://disc.gsfc.nasa.gov/hydrology/index.shtml>

Assimilated Observations



Integrated Output



Courtesy Matt Rodell, NASA-GSFC

GLDAS Data Access on Giovanni

http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=GLDAS10_M

Global Land Data Assimilation System 1.0 Degree Monthly Products

Home

Remove All

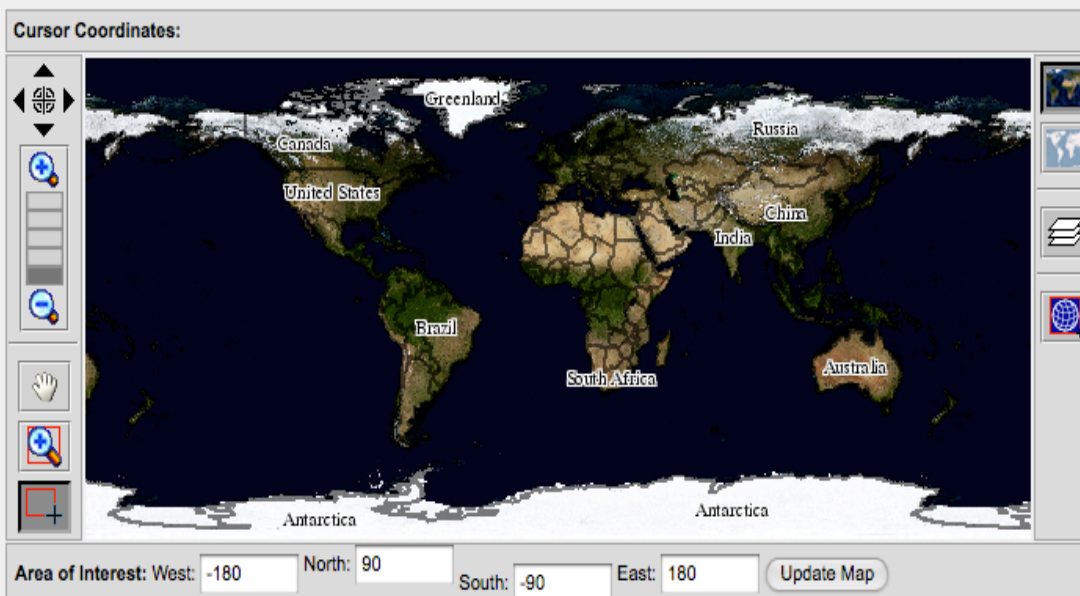
The Global Land Data Assimilation System (GLDAS) is generating a series of land surface forcing (e.g. precipitation, surface meteorology and radiation), state (e.g., soil moisture and temperature, and snow), and flux (e.g., evaporation and sensible heat flux) data simulated by land surface models.

Current GLDAS data holdings include a set of GLDAS Version 1 (GLDAS-1) 1.0 degree resolution data (1979 - present) from CLM, Mosaic, NOAH, and VIC models; a set of GLDAS Version 2 (GLDAS-2) 1.0 degree resolution data (1948 - 2008) from CLM, Catchment, NOAH, and VIC models; GLDAS-1 0.25 degree data (2000 - present) from Noah model, and GLDAS-2 0.25 degree data (1948 - 2008) from NOAH model. This instance focuses on GLDAS-1 and GLDAS-2 1.0 degree monthly products.

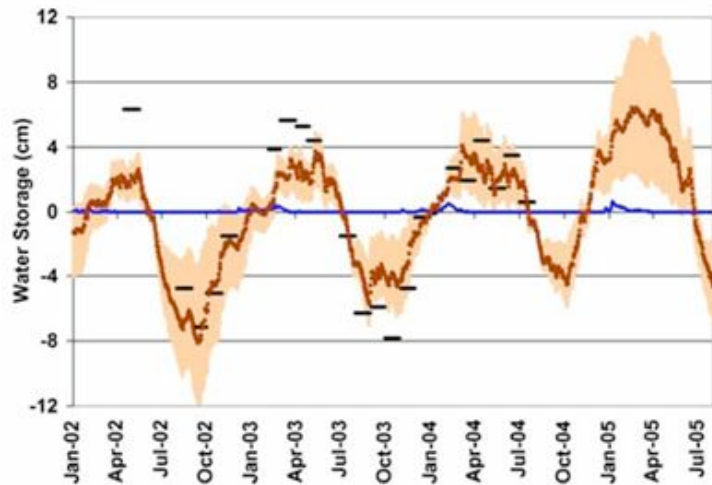
2011-09-08: Please notice that GLDAS Version 2 NOAH Model Experiment 1 product, GLDAS_NOAH10_M_E1.002, is now available in this instance.

Select:

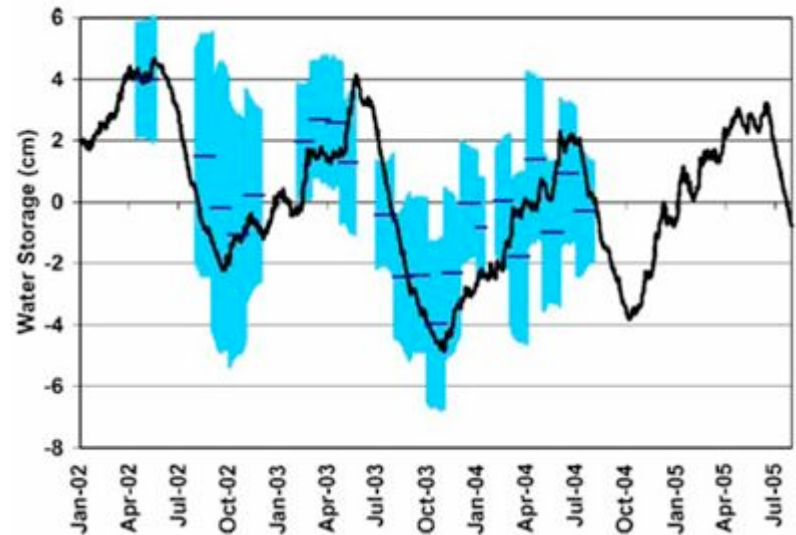
Spatial



Monitoring water storage with GLDAS and GRACE



GRACE derived terrestrial water storage (*black bars*), and the means from three GLDAS land surface models of soil moisture (*brown dots*) and snow (*blue line*), as deviations from their means, presented as equivalent layers of water (cm) averaged over the Mississippi River basin. The length of each black bar represents the extent of the GRACE averaging period. The tan shaded area depicts the range of the modeled soil moisture values. [From Rodell et al. (2006)]



Groundwater storage estimated from GRACE and land surface models using Eq. 1 (*dark blue bars*), and based on monitoring well observations (*black line*), as deviations from their GRACE-period means, presented as equivalent layers of water (cm) averaged over the Mississippi River basin. The length of the dark blue bars represents the extent of the GRACE averaging period. The light blue shaded area depicts computed uncertainty in the GRACE-GLDAS estimates. [From Rodell et al. (2006)]

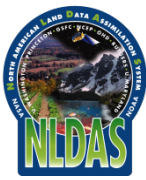
Rodell, M., J. Chen, H. Kato, J. Famiglietti, J. Nigro, and C. Wilson, 2006: Estimating ground water storage changes in the Mississippi River basin (USA) using GRACE, *Hydrogeology Journal*, doi:10.1007/s10040-006-0103-7

North-American Land Data Assimilation System (NLDAS)

- A collaboration project among : NOAA/NCEP's Environmental Modeling Center ([EMC](#)), NASA's Goddard Space Flight Center ([GSFC](#)), [Princeton University](#), the [University of Washington](#), the NOAA/NWS Office of Hydrological Development ([OHD](#)), and the NOAA/NCEP Climate Prediction Center ([CPC](#))
- Spatially and temporally consistent, land-surface model (LSM) datasets from the **best available observations and model output**.
- Specifically intended to reduce the errors in the stores of soil moisture
- Currently running in near real-time on a 1/8th-degree grid over central North America; retrospective NLDAS datasets and simulations also extend back to January 1979.



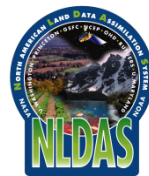
Earth Observations in NLDAS-2



- Forcing is hourly, $1/8^{\text{th}}$ degree, over CONUS and parts of Canada/Mexico (25-53N; 125-67W)
 - NARR model surface data used as base (3 hourly, 32km, Jan 1979 – Present)
 - NARR SWdown at surface is bias-corrected using GOES radiation budget data
 - Hourly NLDAS precipitation based on CPC daily PRISM-corrected gauge data, hourly Stage II Doppler radar data, half-hourly CMORPH, hourly HPD data, and 3-hourly NARR model data (depending on location and data availability)
 - Elevation correction for temperature, pressure, humidity, and longwave



Earth Observations in NLDAS



- Forcing is hourly, $1/8^{\text{th}}$ degree, over CONUS and parts of Canada/Mexico (25-53N; 125-67W)
- Numerous observations (too many to list) used in the generation of the NARR/R-CDAS reanalysis used as backbone of NLDAS forcing
- Precipitation gauge analyses, Stage II Doppler radar, CMORPH
- GOES UMD SRB shortwave radiation data for bias-correction
- Land mask/cover datasets from AVHRR and MODIS (UMD, IGBP)
- Albedo, greenness, and LAI/SAI from AVHRR (soon, MODIS)
- STATSGO (over CONUS) and FAO (outside CONUS) soil info
- GTOPO-30 ~1-km elevation dataset
- LSM-specific observations used as parameter values and during model development and evaluation
- Planned: SWE, SCA, and soil moisture from MODIS/AMSR-E
- Planned: GRACE-based terrestrial water storage; MODIS irrigation
- Future: Soil moisture from SMAP (and from SMOS?)

NLDAS Data Access on Giovanni

http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=NLDAS0125_H

North American Land Data Assimilation System (NLDAS)

0.125 degree Hourly Products

Home

Remove All

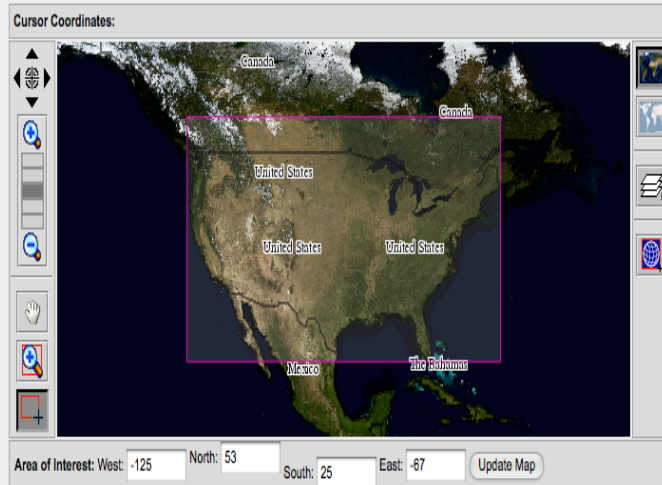
North American Land Data Assimilation System (NLDAS) is generating a series of land surface forcing (e.g., precipitation, surface meteorology and radiation), state (e.g., soil moisture and temperature, and snow), and flux (e.g., evaporation and sensible heat flux) products simulated by four land surface models (SAC, Mosaic, Noah and VIC).

Current data holdings include a set of 0.125 degree resolution data products from forcing data and Mosaic and Noah models, covering 1979 to the present. This instance focuses on NLDAS Phase 1 and Phase 2 0.125 degree hourly products.

2012-03-28: Please notice that NLDAS Phase 2 NOAH Model data set, NLDAS_NOAH0125_H.002, is now available in this portal.

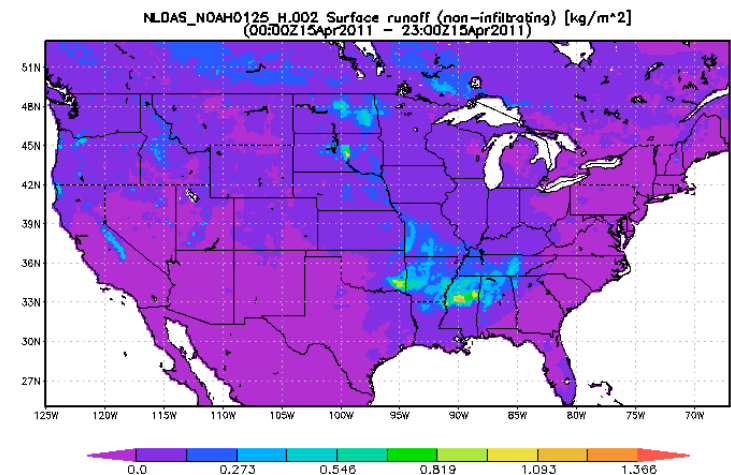
Select:

Spatial



<input type="checkbox"/>	NLDAS-2 Noah Model (0.125x0.125 degree) (1979/01/02 - 2012/06/09)
<input type="checkbox"/>	Snow melt
<input type="checkbox"/>	Snow water-equivalent (accumulated)
<input type="checkbox"/>	Snowfall (frozen precipitation)
<input type="checkbox"/>	Soil moisture availability (root zone, 0-100 cm)
<input type="checkbox"/>	Soil moisture availability (total column, 0-200 cm)
<input type="checkbox"/>	Soil moisture content (layer 1, 0-10 cm)
<input type="checkbox"/>	Soil moisture content (layer 2, 10-40 cm)

Surface Run Off – April 15th 2011



NLDAS Applications

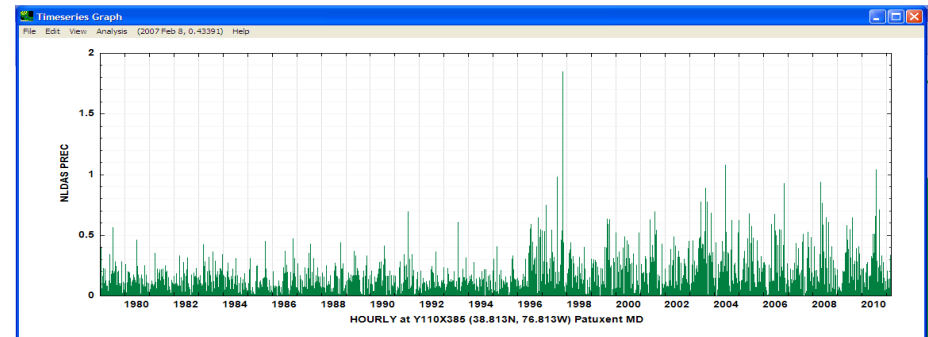
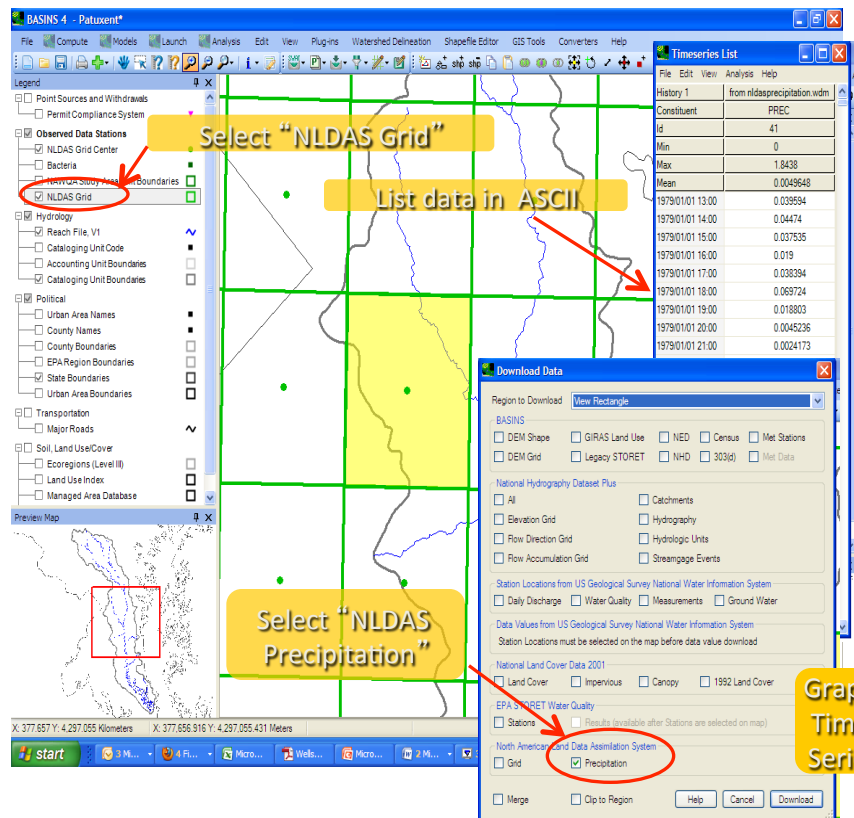
Potential to be very useful for monitoring water resources at high spatial and temporal resolutions for a variety of applications



NLDAS-2 precip used in EPA BASINS

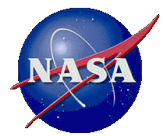


- The **B**etter **A**ssessment **S**cience Integrating **P**oint & **N**onpoint **S**ources (BASINS) environmental analysis system, created by the EPA, now can use NLDAS-2 hourly precipitation from the GES DISC, via the GDS
- Nigro et al. (2010) showed “dramatic” improvements in water quality model performance when using NLDAS-2 precipitation in BASINS

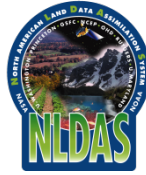


Left: Screen capture of the BASINS v4.0 interface, showing the availability of NLDAS data. Above: 32-year time series of NLDAS-2 precipitation, generated by BASINS.

Courtesy: David Mocko

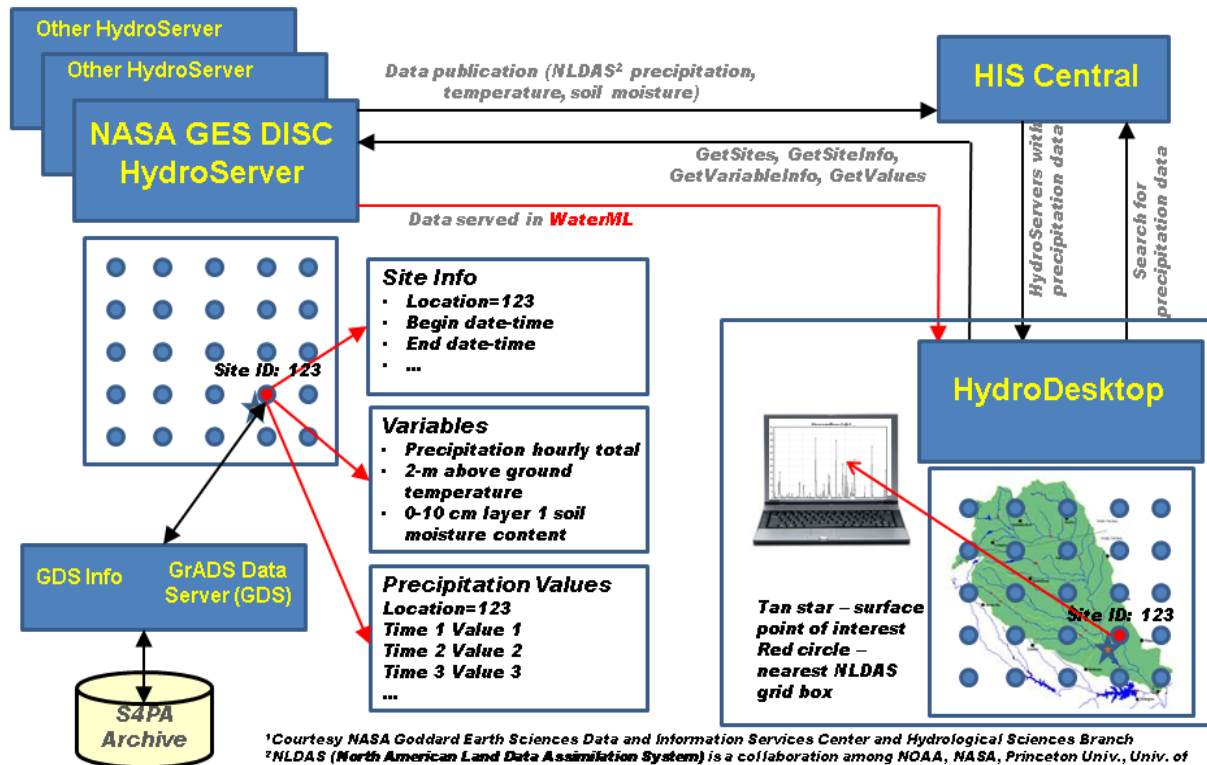


LDAS datasets to be added to CUAHSI



- The GES DISC is working to integrate NLDAS & GLDAS data into the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) Hydrologic Information System (HIS)

NASA Hydrologic Data Access from HydroDesktop (an example)¹



¹Courtesy NASA Goddard Earth Sciences Data and Information Services Center and Hydrological Sciences Branch
²NLDAS (North American Land Data Assimilation System) is a collaboration among NOAA, NASA, Princeton Univ., Univ. of Washington, and others.

A Web Service to provide the data as a time series along with corresponding metadata in WaterML are in development; this figure shows a schematic of the data access using the CUAHSI HIS client HydroDesktop; the data can be searched, retrieved, and analyzed along with hydrological data from other sources available via HIS.

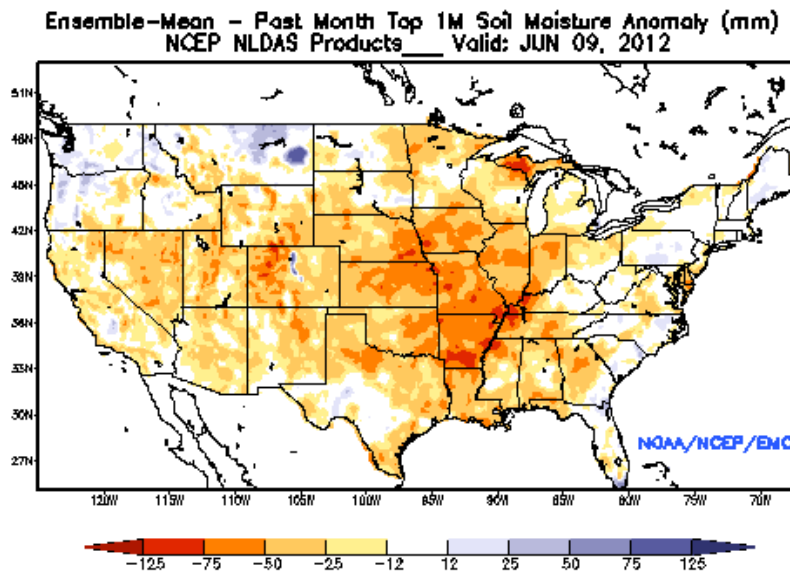
Courtesy: David Mocko

NLDAS Applications

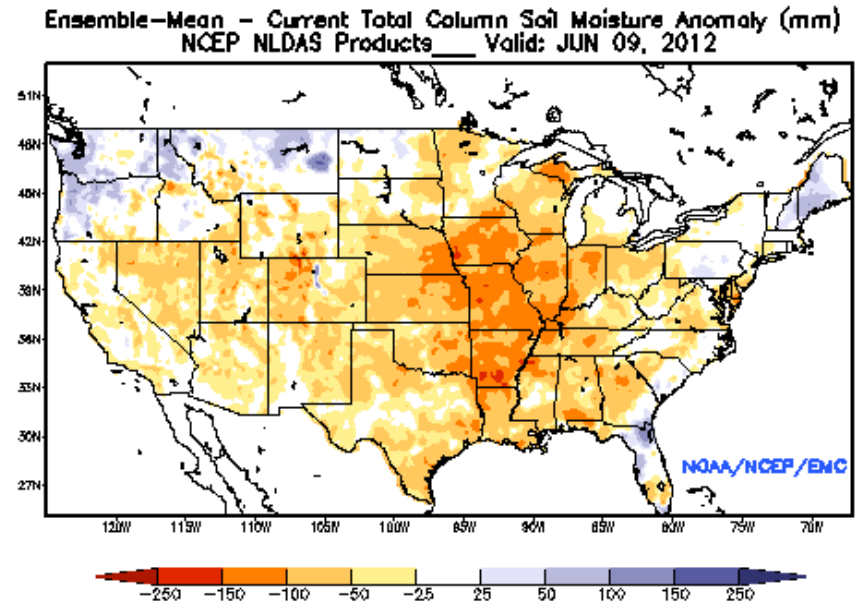
NLDAS Drought Monitor:

NLDAS provides information for monitoring current surface water budget (rain, soil moisture, ET, run-off)

<http://www.emc.ncep.noaa.gov/mmb/nldas/drought/>



Past Month from 9th June



9th June

Total Column Soil Moisture from NLDAS – notice the below normal soil moisture

Thank You!